SSVEO IFA List

Date: 02/27/2003
Time: 04:09:PM

STS - 65, OV - 102, Columbia (17)

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	MET:	Problem	FIAR	IFA STS-65-V-01	OI - Recorders
INCO-03	GMT:		SPR 65RF01	UA	Manager:
			IPR 73V-0003	PR	
					Engineer:

Title: OEX System Control Module Stopped Executing Commands (ORB)

Summary: INVESTIGATION/DISCUSSION: At 191:12:30 G.m.t (01:19:47 MET), a Go-To-Mark command was sent to the system control module (SCM). The SCM executed the command which positioned the Orbiter Experiments (OEX) recorder tape to a pre- determined location for recording data. At 191:21:08 G.m.t. (02:04:25 MET), the Go-To-Mark command was again sent to the SCM for execution. Subsequent commands were sent to the SCM to begin recording data; however, the commands were not executed because of a SCM software lock-up condition. With the SCM malfunction, the remaining OEX on-orbit and entry data were lost.

Postlanding, the SCM battery boards, which maintain system memory, were removed, and the SCM was powered-up from a known memory configuration. Commands sent to the SCM were then executed successfully and the (Continued on the next page)recorded mission data were dumped to a ground recorder. KSC was able to reproduce the lock-up condition (with and without the SCM battery boards installed) by issuing the same redundant command sequence used on-orbit. The KSC troubleshooting was able to prove that the battery boards were not at fault and the cause of the failure was the previously unidentified SCM command sequence limitation. CAUSE(s)/PROBABLE Cause(s): The OEX SCM malfunction was caused by the sending of two consecutive Go-To-Mark commands, causing the SCM to enter a software lock-up condition that could only be cleared by removing the battery boards. CORRECTIVE_ACTION: After the recorded data were dumped, KSC was able to reproduce the lock-up condition (with and without the SCM battery boards installed) by issuing the same redundant command sequence used on-orbit. This troubleshooting proved that the battery boards were not at fault and the cause of the failure was the previously unidentified SCM command sequence limitation. As a result, a Shuttle Operational Data Book (SODB) addition has been made to document this limitation. RATIONALE FOR FLIGHT: Vehicle data recorded by the OEX hardware is not mission critical nor safety of flight critical; however this data is recognized as significant to both the SSME Project and some payload customers. OV-102 is the only vehicle equipped with the OEX hardware. The other vehicles are equipped with modular auxiliary data system (MADS) to record this criticality 3 data. The MADS does not incorporate an SCM.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-65-V-02	Water and Waste
EECOM-02	**GMT:**		**SPR** 65RF02	**UA**	**Manager:**
			IPR 73V-0017	**PR**	
					Engineer:

Title: Supply Water Dump Nozzle Icing (ORB)

Summary: INVESTIGATION/DISCUSSION: During the third supply water dump, data analysis indicated that ice had formed on the supply water dump nozzle. The supply water dump nozzle temperature decreased sharply to 50 degrees F from 134 degrees F. To remove the ice from the nozzle and surrounding area, several nozzle bake-outs were performed. The data from the bake-out period were erratic, indicating ice in the nozzle area.

The OV-102 supply water nozzle is not an ideal configuration with reference to the surrounding tile. It is the deepest recessed nozzle of all the vehicles. The tile tapers down to 1/10 in. below the nozzle face. Though, it currently meets the drawing specifications, a change is in work to update the drawings to reflect a nozzle position farther outboard of the bondline. The nozzle face should protrude beyond the tile face with the tile tapered up to 1/10 in. below the nozzle face. A change is being implemented to move the dump nozzle farther outboard. A dump nozzle flow check was performed at Kennedy Space Center. The flow and spray pattern of the supply water was nominal. During the inspection postflight, signs of isophobic grease were present in the form of streaks on the nozzle face. The isophobic grease looked like it had boiled from the 270 degree to the 360 degree position. Approximately .5 in of isophobic grease is missing at the 360 degree position. It is believed that the boiling occurred during entry Should the supply water system fail, the supply water can be dumped through the flash evaporator system (FES). Should the FES be unavailable, two contingency waste containers are available. The contingency waste containers each hold 95 lb of water each. As a undesirable alternate method, supply water can be dumped through the waste water dump system. CAUSE(s)/PROBABLE Cause(s): The most likely cause for the supply water dump nozzle icing is improper nozzle position. CORRECTIVE_ACTION: Update current Orbiter supply water nozzle drawing specifications and reposition the dump nozzle to reflect the drawing changes. RATIONALE FOR FLIGHT: The supply water nozzle is being repositioned to prevent icing. Should the supply water system fail, the supply water can be dumped through the flash evaporator system (FES). Should the FES be unavailable, two contingency waste containers are available. The contingency waste containers each hold 95 lb of water each. As a undesirable alternate method, supply water can be dumped through the waste water dump system.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-65-V-03	Water and Waste
EECOM-01,03,05	**GMT:**		**SPR** 65RF10, 65RF03	**UA**	**Manager:**
			IPR	**PR** V070-2-18-0326	
					Engineer:

Title: WCS Problems: A) Commode Fault During Compaction Cycle B) Commode Filter Anomalies and Odor Management C) Fan Separator 1 Stall and Liquid Backflow (ORB)

Summary: INVESTIGATION/DISCUSSION: A) During the third compaction cycle, the Extended Duration Orbiter (EDO) waste collection system (WCS) commode fault light was illuminated. Data indicate that the compactor piston stopped approximately at the bottom of the transport tube, or midway in the retraction stroke. The crew inspected the transport tube for hardware damage and found none. Following the inspection, the crew configured the system for normal operations, and the compactor operated nominally for the remainder of the mission. During the postflight crew debriefing, the crewmenber that was using the commode at the time of the fault indicated that the compactor release button was pressed before the compaction cycle was complete. The commode design is such that the compaction cycle will be terminated when the release button is pressed. This is the only method to abort a compaction cycle.

B) Late in the flight day three activities, the crew reported that they experienced difficulty in replacing the commode odor/bacteria filter during the scheduled changeout. The next day, the crew examined the filter and reported that the filter was out-of-tolerance but could be forced into position. During the flight day 12 activities, the crew was able to install this out-of-tolerance filter using some surgical lubricant on the grommet along with one crewmenber pushing while a second crewmember rotated the filter. The postflight examination of the filter revealed that the top of the filter canister was improperly assembled. The improper assembly resulted in some of the filter locking tabs being out of position at an angle. The incoming inspection performed at the vendor only inspected one side of the filter canister. On flight day 6, the crew reported smelling odors whenever the commode was running. The crew changed the commode odor/bacteria filter and installed a second charcoal filter in the atmospheric revitalization system (ARS). The crew reported some improvement in the severity of the commode odors. The next day the crew changed out the EDO WCS plenum filter and reported that the odors had been eliminated. At the time of the plenum filter changeout, the crew reported that the filter appeared dry but was retaining odors. C) On flight day 13, WCS fan separator 1 exhibited an unusual signature and the crew reported a gurgling noise and odor from fan separator 1 during operation. The data indicate that liquid was still in the bowl when the fan separator shut down. Two fan separator cycles were immediately performed, and the separator rpm did not reach the normal operating speed during either cycle. On the third cycle, the separator rpm had dropped below the minimum operating speed. This caused the controller to shut down the fan separator and signal a urinal fault. Following this occurence, the crew switched to fan separator 2, which was used for the remainder of the mission. The flight data indicate that a possible 10-second liquid backflow through the dual fan separator 1 outlet check valves after the previous use may have resulted in the flooding of the fan separator. During postflight activities on the day following landing, liquid backflow from the waste tank through the check valves occurred when the water tanks were repressurized for supply water sampling. A four-gallon reduction of the waste water quantity was noted, and water overflowed into the middeck area. The middeck was cleaned and disinfected. The EDO WCS was removed from the vehicle and returned to the vendor. An examination of the two failed check valves revealed a build-up of urine solids that prevented the check valves from closing. The regular WCS fan-separator outlet-check valves are of a different design with a Teflon poppet that is less succeptible to a build-up of urine solids. Requirements are being developed for a two-flight Development Test Objective (DTO) to test the effectivity of a citric-acid urine pretreatment. As urine cools, the pH of the liquid rises and this in turn allows the solids to sublimate out of solution. The pretreatment is designed to lower the pH and keep the urine solids in solution. CAUSE(s)/PROBABLE Cause(s): A) The cause of the commode fault light and incomplete compaction cycle was the interruption of the cycle by the premature pressing of the compactor release button. B) The cause of the difficulty in installing the commode odor/bacteria filter was

the result of the improper assembly of the filter canister and a failure of the manufacturer's inspection process to identify improperly assembled filter canisters. The cause of the commode odors is unknown. C) The fan separator 1 stall was caused by a backflow of liquid from the waste water tank into the fan separator. The liquid backflow was caused by urine solids coming out of suspension in the WCS lines and collecting on the check valves, which in turn caused the valves not to be able to seal. CORRECTIVE_ACTION: A) No corrective action is required as the system performed as designed and intended. (continued) B) Additional inspection steps will be added to the incoming inspection at the vendor to verify that the filters are assembled properly. Due to funding limitations, an analysis of the commode plenum filter to determine why it was retaining odors will not be performed. C) The urine residue will be cleaned from the EDO WCS; however, the unit will not be refurbished and readied for flight until funding levels are restored to support the work. A urine pretreatment DTO is under development to determine if treating the urine with citric acid will prevent urine solids from forming on the fan separator outlet check valves. RATIONALE FOR FLIGHT: The EDO WCS will not be refurbished or manifested for flight until such time as funding for the program is reinstated to allow completion of the failure analysis and refurbishment of the hardware. The regular WCS fan-separator outlet-check valves are of a different design with no history of a significant build-up of urine solids on the Teflon poppets or sealing areas. The regular WCS units do not make use of a commode-plenum filter.

Tracking No	**Time**	**Classification**	**Documentation**		**Subsystem**
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-65-V-04	GN&C
GNC-01	**GMT:**		**SPR** 65RF04	**UA**	**Manager:**
			IPR	**PR** GNC-2-18-1012	x36123
					Engineer:

Title: IMU 1 Redundant Rate BITE (ORB)

Summary: INVESTIGATION/DISCUSSION: During STS-65 on-orbit operations, an inertial measurement unit (IMU) 1 redundant-rate built-in test equipment (BITE) message was annunciated at 199:12:36 G.m.t. (09:19:53 MET) when the redundant gyro- axis rate output stepped to 0.98 deg/hr for a 22-second period. The 0.98 deg/hr value exceeded the 0.7-deg/hr general purpose computer (GPC) software BITE limit. Data review indicated that these transients began occurring at 197:17:43 G.m.t. (08:01:00 MET); however, neither the amplitude nor the duration of the transients was initially large enough to set the BITE indication. The redundant gyro-axis rate-output transients continued occurring at random intervals with varying amplitude and duration. IMU 2, which had been in standby due to the Group-B-priority powerdown, was brought out of standby at 201:14:29 G.m.t. (11:21:46 MET) to ensure redundancy should IMU 1 have degraded further. All three IMUs were maintained in operate for the remainder of the mission.

The amplitude and duration of the drift transients tended to increase as the flight progressed with the longest drift transient lasting 93 minutes. Resolver data initially showed small step shifts in platform alignment during the transients that returned to normal when the transient cleared. The platform eventually began to drift at rates up to 3.1 deg/hr and remain misaligned after the longer transients. IMU 1 was periodically realigned to ensure that platform misalignment caused by the drift transients did not exceed the redundancy management (RM) threshold. A significant indication of residual platform misalignment occurred at 201:18:38 G.m.t. (12:01:55 MET), after which the flight control team declared IMU 1 failed for entry-planning purposes. IMU 1 performance was determined to be acceptable for use in the RM set for the remainder of the mission and during entry. The crew's schedule changed from dual- to single-shift operations as the flight neared completion. The IMU was deselected for the last sleep period prior to entry to prevent BITE indications from causing audible alarms and waking the crew. During the flight, the IMU community agreed that if the misalignment of IMU 1 exceeded 0.25 degree between scheduled alignments, the IMU performance would be considered degraded enough to require on-orbit troubleshooting. During the sleep period, a drift transient occurred at 203:20:59 G.m.t. (14:04:16 MET) that caused the accumulated platform misalignment (as compared to IMU 2 and IMU 3) to exceed this 0.25-degree limit. When the crew awoke at the scheduled time, the ground controllers had the crew take the IMU to standby at 204:03:48 G.m.t. (14:11:05 MET) to reset internal processors, then take it back to operate, align it, and return it to the RM set. Drift transients and BITE indications continued to occur, but IMU 1 performance was acceptable for the remainder of the flight. IMU 1 was used for entry and landing without incident. IMU 1 (IMU s/n 204) was removed postlanding and sent to the Inertial Systems Laboratory (ISL) for troubleshooting. Extensive data were recorded to characterize the signature of the anomaly. Unexpectedly high noise levels were detected on the voltage outputs of the DC to DC converter card (card s/n 19). The DC to DC converter card supplies +/-5 Vdc, +/-15 Vdc, and +/-19 Vdc to internal IMU loads. Troubleshooting also revealed that the frequency of the DC to DC converter card's square wave oscillator was out of specification (66 kHz observed, should be 80 +6/-4 kHz). The frequency of the noise detected at the DC to DC converter card outputs was also 66 kHz. A review of historical performance data for IMU s/n 204 revealed that the failure seen in-flight was progressive. A review of performance data for all other high accuracy inertial navigation system (HAINS) units in the fleet was performed and revealed no similar trends, indicating that no similar failure of these units is likely. However, a review of the spare HAINS units revealed that a HAINS has exhibited short-duration rate gyro monitor disturbances. During one of these disturbances, the DC/DC card noise was being monitored and no change in the noise was noted. As a result, the s/n 206 events are not believed to be related to the s/n 204 problem. For comparison, measurements of another IMU's (s/n 202) DC to DC converter card (s/n 10) oscillator frequency and voltage outputs were made. The square wave oscillator frequency was nominal at 80 kHz, and voltages at the outputs were nominal. DC to DC converter card s/n 10 was then removed from IMU s/n 202 and installed in IMU s/n 204. The square wave oscillator frequency remained nominal at 80 kHz. Voltage amplitudes were nominal as well. The faulty DC to DC converter card was then installed in the healthy IMU (s/n 202). IMU s/n 202 experienced occurrences of disturbances. However, the magnitude and the duration of the disturbances was significantly less than that seen while this card was installed on IMU s/n 204, indicating that IMU s/n 204 aggravates the existing card problem. DC to DC converter card s/n 19 was reinstalled in IMU s/n 204, and the IMU was shipped to the vendor for additional troubleshooting and repair. Failure investigation at the vendor revealed a resistance buildup at one of the three press-fit connectors which serve as chassis grounding terminals for the DC to DC card. A jumper will be run around the press-fit connector to create a different grounding terminal as a corrective action for this particular card. There have been two other occurrences of a bad press-fit connector in the HAINS program: D/C to D/C cards s/n 12 and s/n 04. The failures of s/n 04 (which was a non-flight unit) and s/n 19 (this in-flight failure) occurred after the cards went through extensive rework related to the press-fit connector, and this may have contributed to the press-fit problem. Analysis of s/n 19 is continuing and will be documented under CAR 65RF04. The s/n 12 failure is still being investigated for possible contributions to the failure. The only previous failure of IMU s/n 204 was related to excessive gyro trending. During troubleshooting for the excessive trending, the platform inertial components and related platform electronics were thermally overstressed and subsequently required replacement. After repair of the unit, it exhibited excessive intermittent gyro drift. The drift was traced to intermittent ground terminal connections on the DC to DC converter card (s/n 12, mentioned above). The card was replaced with s/n 19, and the IMU passed acceptance testing. Were this failure to recur in-flight and the IMU considered failed, a minimum- duration flight would be declared in accordance with current flight rules. The next primary landing site would be used upon loss of a second IMU. CAUSE(s)/PROBABLE Cause(s): Resistance buildup at one of the press-fit connectors which serve as chassis grounding terminals for the

DC/DC card contributed to the failure of IMU s/n 204. Further analysis will be performed to determine any other contributing factors.   CORRECTIVE_ACTION: IMU 1 s/n 204 was removed and replaced. DC to DC card s/n 19 will have a jumper installed around the failed press-fit connector to create a different grounding terminal. RATIONALE FOR FLIGHT: The three DC/DC cards with known press-fit connector problems are currently not available for flight; they are at the vendor for further failure analysis and possible repair. A data review was performed on the HAINS units in spares and across the fleet with no symptoms indicating this failure mode observed.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	MET:	Problem	FIAR	IFA STS-65-V-05	RCS
PROP-02	GMT:		SPR None	UA	Manager:
			IPR 73V-0004	PR	x38346
					Engineer:

Title: Vernier Thruster R5D Failed Off (ORB)

Summary: INVESTIGATION/DISCUSSION: During a attitude maneuver vernier thruster R5D was deselected by Redundancy Management (RM). RM deselected R5D due to a low chamber pressure. R5D's data indicate that the thruster chamber pressure was 25 pisa for one 0.04 second sample and then returned to zero. R5D was test fired twice successfully and then reselected. The thruster perfomed nominally for the remaining five days of the mission. The thruster was fired 1613 times during the remainder of the mission without failure.

During system trouble-shooting at Kennedy Space Center, the cables and connectors between multiplexer/demulitplexer FA2 and RJDA2 were manipulated.   The flexing of the cables were performed during a RCS single command test with the commands held on until manually released. The current at the R5D was monitored for any dropouts. The connector at the MDM and the connector at the RJDA were disconnected and inspected. The wire between the MDM and RJD was Hi- potted. No problems were noted. Reading the data during the On orbit Anomaly: As the body attitude error-pitch reached +1.0 degree, vernier vet L5D chamber pressure increased from zero to 107 psia. This was followed by R5D 480 ms later. Both chamber pressures sampled at an intermediate value and on the next sample 40 ms later were at full pressure. Both thrusters went off at the same time for an on time of 1.68 seconds for L5D and 1.2 seconds for R5D.   This was a normal firing. The duration was long enough for the GPC commands at 1 sample/second and the chamber pressure discretes also at 1 sample/second to indicate the on condition. Also the thruster driver measurements at 12.5 samples/second indicated proper operation. After an off time of 7.76 seconds the chamber pressures again showed change. L5D chamber pressure read 48 psia followed by full pressure on the next sample. The thruster was on for 0.48 second. R5D chamber pressure read 25.6 psia followed by 7.2, 0.8, 0.0 on the next three samples. The thruster driver measurement did not indicate an on. This indicates that the thruster could not have been on for 80 ms else the driver would have had at least one sample in the on state since it samples at an 80 ms rate (12.5 samples/second). The chamber pressure indicates that it did not reach full pressure since the readings do not match the normal turn off pressure decay.   It appears the thruster was commanded on for approximately 25 ms and thus went off about the time the fuel and oxidizer valves were opening. The thruster and its interface with the Reaction thruster Driver Aft (RJDA): Two wires go from the RJDA and the vernier thruster valve coils, one for the fuel valve and one for the oxidizer valve. The wire wrap modification to detect burn-thru was not made to vernier thrusters, thus the valves are not tied together. A bad connection would affect one valve which would result in flowing either fuel or oxidizer from the other valve. The flowing of the cold propellant would result in an injector temperature decreasing indicating which valve was flowing. For normal firings, the injector temperatures increase due to soak back of the heat from the thrust chamber. R5D injector temperatures were stable and did not show any increase or decrease at the time of the anomaly. If the return side of the of the solenoids had a bad connection, this would affect both valves. If that were the problem, the thruster driver measurement would have indicated on without the thruster responding. The Redundancy Management (RM) runs at 12.5 Hz (80 ms). The RM could not reach a count of three without the driver measurement indicating an on because it samples at the same 80 ms rate. Therefore, this area has been eliminated as a possible source of the problem. The commands that turn a thruster on: The reaction jet dirver assembly requires two commands to turn a thruster on.   The first is Command A which is a Toggle Command. The other is Command B which is the Enable Command. The off state is Command A set to a logic 1 (five volt MDM discrete on) and Command B set to a logic zero (five volt MDM discrete off). To turn the thruster on, Command A is set to logic zero and thereafter toggled to the opposite state every 40 ms for as long as the thruster is to remain on. Command B is set to logic 1 and maintained for the duration of the firing. As soon as Command B goes to logic zero off state, the thruster is turned off. Once the thruster is turned on (Command A transitions to the zero state), whether Command A stays at zero or transitions to the 1 state and freezes there; or the wire opens so that the command would be zero volts the thruster will still be on for approximately 130 ms from the last transition to zero. If Command A were somehow left in the zero state or was transitioned to zero while the enable was off, this would result in an 80 ms delay when the thruster was commanded to fire. This would not be long enough for the RM to declare the thruster failed. Therefore, this problem can not be caused by Command A. However, when Command B goes off (logic zero) or a bad connection drops the voltage to zero, the thruster driver will go off in less than 5.3 ms. Therfor, Command B was the likely suspect. Kennedy Space Center Ground testing with trickle current measurement: The trickle current measurement was used to monitor the results of the commands while flexing wire segments and bundles. The trickle current circuits applies a regulated 20 vdc through current limiting resistors which limit the current to approximately 100 ma for primary thrusters and 50 ma for vernier thrusters. With the thrusters off the trickle current comparator will see the 20 vdc and the measurement will indicate the zero off state. With R5D commanded on (Command A toggling and Command B logic 1), the current flows and drops the voltage across the limiting resistors. The trickle current comparator will see only the voltage drop across the valve coils and the Darlington transistor stage that drives them. This will be a little over two volts dc and the trickle current measurement will indicate the on state. If Command B were to drop out due to a bad connection during the wire flexing, the driver would go off. The voltage would go back to the 20 volts dc and the measurement would again indicate off. No problems were found during the troubleshooting.   CAUSE(s)/PROBABLE Cause(s): The cause of the vernier thruster R5D being deslected by redundance management is most likely caused be a loss of the Command B logic.   CORRECTIVE_ACTION: None.   RATIONALE FOR FLIGHT: The vernier thruster R5D was fired 1613 successfully for 5 days post RM deselect. All possible causes of the vernier jet deslection have been investigated.

Tracking No	**Time**	**Classification**	**Documentation**		**Subsystem**
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-65-V-06	Water and Waste
EECOM-07	**GMT:**		**SPR** 65RF05	**UA**	**Manager:**
			IPR 73V-0016	**PR**	
					Engineer:

Title: Low Waste Dump Flow (ORB)

Summary: INVESTIGATION/DISCUSSION: During STS-65 three waste water dumps were scheduled and completed. The first dump cycle was nominal. During the second waste water dump, the flow rate decreased from 2.03 percent per minute to 1.11 percent per minute. During the third waste water dump the flow rate ranged from 1.2 percent to 1.4 percent. A normal waste dump flow rate is 1.7 percent to 2.1 percent. This degradation in flow rate is similar to the data experienced on STS-35, 42 and 50. The cause of the STS-35 decreased flow rate was degradation of the urine solids filter. The STS-50 degraded flow was due to urine solids overloading the urine solids filter.

Postlanding inspection found the waste water nozzle to have a brown residue in the shape of a donut surrounding the nozzle area. Kennedy Space Center personnel removed a sample for analysis. Additional flow checks and sampling found Calcium Phosphate (urine solids) down stream of the filter. The urine solids filter was removed by KSC personnel. Inspection of the filter at NSLD revealed a large amount of urine solids that prevented an adequate flow of fluid through the filter as occurred on STS-50/OV-103. The filter, however was not degraded as found on STS-35. The urine solids filter has been removed and replaced each flight since STS-55. A citric acid flush of the waste water system plumbing has been added to the Operational Maintenance and Requirements and Specifications for STS-65 and subsequent missions to clean the waste management system plumbing. A contingency waste water dump filter is available to bypass a blocked filter and continue dumping. Should the waste water dump system become unusable due to blockage, two contingency water containers are on-board which can offload 190 lb of waste water; 190 lb is equivalent to 4.8 days. The waste tank can also hold 165 lb or 4.2 days. Additionally, waste water dumps could be performed through the supply water dump system. However there is a risk of contaminating the supply water. It will also require additional turnaround maintenance to sterilize the system. CAUSE(s)/PROBABLE Cause(s): Blocked urine solids filter which reduced the waste water flow rate to the nozzle. CORRECTIVE_ACTION: An on-orbit urine pretreatment is being considered to reduce the possibility of solids forming in the WMS plumbing and collecting on the urine solids filter and blocking the flow. A citric acid flush has been developed to clean any residual solids out of the system preflight. A contingency filter is available to bypass the urine solids filter in the event of blockage. RATIONALE FOR FLIGHT: The citric acid flush will provide a much cleaner system initally. A contingency filter is available in the event of a blocked urine solids filter. Contingency water containers are available in the event that all other means for handling waste water are exhausted.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-65-V-07	OI - Recorders
INCO-09	**GMT:**		**SPR** 65RF06	**UA**	**Manager:**
			IPR 73V-0005	**PR**	
					Engineer:

Title: Poor Dump Quality Ops Recorder 2 Track 2 (ORB)

Summary: INVESTIGATION/DISCUSSION: At 201:00:34 G.m.t. (011:07:51 MET), poor quality dump data were received from track 2 of operations (OPS) recorder 2 while dumping at the 8:1 ratio. The data were poor in both the forward and reverse directions through Ku-Band channel 2. Good quality data were received when dumping at the 1:1 ratio through a ground site. OPS recorder 2's tracks 4 through 14 were used as only an acquisition of signal (AOS) recorder for the remainder of the mission because of the problem with track 2.

The postlanding dump of OPS 2 recorder track 2 through the T-O umbilical at the 8:1 ratio was unsuccessful due to poor quality data. Track 2 was then re- recorded in both directions. Subsequent playback resulted in good data in the forward direction and poor data in the reverse direction. The recorder was removed and sent to the NASA Shuttle Logistics Depot (NSLD) to verify the problem. NSLD was able to duplicate the flight and ground testing. All testing indicates that the most probable cause of the poor data on OPS 2 Recorder is the reverse record head or the reverse record electonics. CAUSE(s)/PROBABLE Cause(s): The most probable cause of the poor data on OPS 2 Recorder track 2 is the reverse record head. The failure analysis will be documented in CAR 65RF06-010. CORRECTIVE_ACTION: NSLD verified flight and ground test results by performing additional recording and playback. All testing indicates that the most probable cause of the failure is the reverse record head or the reverse record electronics. The unit will be returned to the vendor for repair after a new repair contract has been negotiated. RATIONALE FOR FLIGHT: The Orbiter has two OPS recorders for recording and dumping data. After the poor quality data dump of OPS recorder 2 was determined, there was no further loss of data from the Orbiter.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-65-V-08	MPS
None	**GMT:**		**SPR** None	**UA**	**Manager:**
			IPR 73V-0014	**PR**	
					Engineer:

Title: LH2 Manifold Pressure Following Vacuum Inert (ORB)

Summary: INVESTIGATION/DISCUSSION: See page 2.During STS-65, the main propulsion system (MPS) LH2 manifold pressure unexpectedly rose to 17 psia following vacuum inert and then decayed to 0 psia at a rate that was higher than expected. STS- 65 was the first flight of the operational increment (OI)-23 software and therefore, was the first use of the MPS propellant dump procedure designed for OI-23.

The MPS dump procedure developed for OI-23 automated the MPS dump/vacuum inert process and was intended to improve the dump capability for return-to-launch- site (RTLS) and transoceanic abort landing (TAL) aborts. The significant differences between the OI-22 and OI-23 versions of the MPS dump include the following items. In OI-23, the RTLS dump valves (PV17 and PV18) are opened at MECO+10 seconds and left open until termination of the dump (the dump is initiated at MECO+120 seconds and the dump duration is 120 seconds), whereas in OI-22 the RTLS dump valves are opened at MECO+10 seconds and closed at MECO+80 seconds and remain closed. The inboard (I/B) fill and drain (F&D) valve (PV12) is open for 20 seconds at dump initiation in OI-23 versus 6 seconds in OI-22. The high point bleed system is not inerted in OI-23, that is, the high point bleed valve (PV22) is not opened. The LH2 manifold is pressurized using the RTLS repressurization system in OI-23 versus the normal manifold repressurization system in OI-22. And finally, in OI-23, the bakeout period between dump termination and vacuum inert initiation is automated by the software to 5 minutes in OI-23, whereas in OI-22 the vacuum inert is initiated manually with the nominal bakeout period lasting 6 to 9 minutes. After a thorough review of the flight data and the performance of various analyses, the following conclusions were drawn. At the termination of the dump (prior to vacuum inert), the residual hydrogen in the manifold was approximately 1.5 lbm, as compared with 6.5 lbm following the STS-62 dump (previous flight of OV-102). Comparisons with additional flight data indicate that the post-dump residual was less than the OI-22 dump average; however, it was greater than the pre-flight predicted OI-23 post-dump quantity of approximately 0.3 lbm. The greater than expected post-dump residual can be attributed to the loss of RTLS repressurization system helium (approximately 40 percent) through the LH2 manifold relief valve (RV6). This loss of helium was discovered prior to flight during the RTLS repressurization valves (LV74 and LV75) verification test but was not expected to significantly affect the post-dump residual. The post-dump residual coupled with the software controlled 5-minute bakeout period between dump termination and vacuum inert initiation did not allow for a complete vaporization of the hydrogen residual. Note that the 5-minute bakeout period was based on the lower expected hydrogen residual and the greater expected helium quantity in the manifold. Therefore, the residual hydrogen after vacuum inert was just under 1 lbm, which is much greater than expected or what is normally seen. This subsequently caused the pressure increase as residual hydrogen in the manifold vaporized. Although there were no safety-of-flight issues raised with the performance of the OI-23 MPS dump, issues regarding the use of the RTLS repressurization system hardware and the dump/vacuum inert effectiveness were raised. The hardware issue was raised because neither the LH2 manifold isolation valve (PV8) or the manifold relief valve were formally certified for RTLS repressurization system flow. Subsequent investigations have revealed that these components saw limited use in this manner during main propulsion test article (MPTA) tests as well as during component qualification. Based on this data and satisfactory STS-65 performance, all vehicles are being certified for one flight of the present OI-23 software and a delta certification will be performed prior to STS-63 (first instance of OI-23 reflight) to formally certify the manifold isolation valve and relief valve for RTLS repressurization system use. To improve the dump effectiveness and eliminate the hardware concern for nominal missions, the OI-23 MPS dump/vacuum inert procedure will be modified (targeted for implementation on STS-67). The I/B F&D valve will be open throughout the dump (versus closing at dump initiation+20 seconds) and the use of helium during the dump will be eliminated. This same dump procedure was successfully used during STS-51D as part of a detailed test objective (DTO). To improve the vacuum inert effectiveness, the bakeout period between dump termination and vacuum inert initiation will be increased from 5 to 15 minutes. A bakeout period of this duration should allow for the vaporization of a post-dump residual of up to 5 lbm, which is significantly greater than expected. The vacuum inert duration is being reduced from 5 minutes to 1 minute. This duration will allow sufficient time to inert the propellant manifolds and insure that the feed systems are secured prior to the OMS-2 burn. A final modification will reinstate the manual opening of the high point bleed valve during vacuum inert so that the high point bleed line can be inerted. This valve cannot be cycled via software commands and was left closed on STS-65. Inerting of any hydrogen remaining in the line was accomplished through normal system leakage. Postflight testing of the Orbiter MPS system was performed to determine the cause of the greater-than-expected pressure decay seen following the post- vacuum-inert pressure rise and to determine if the LH2 RTLS repressurization system hardware had been damaged during flight. The pressure decay seen on orbit corresponded to a system leak rate of approximately 7000 scim. Although this decay rate is greater than expected and greater than allowable for a pressure decay at ambient temperature, it does not exceed the system leak rate at cryogenic temperatures. Testing included a large volume decay test and out- of-specification leakage was recorded (IPR 73V-0026). The measured leakage was 0.696 psi/hr and it should have been no-greater-than 0.601 psi/hr. Troubleshooting found a 94 scim leak at the Space Shuttle main engine (SSME) 2 high pressure fuel turbopump (HPFTP) and it should have been less-than 50 scim. This leakage may have been a significant contributor to the leakage seen on orbit, however, that cannot be stated conclusively. No anomalies or out-of-specification leakages were noted in the Orbiter MPS system. CAUSE(s)/PROBABLE Cause(s): The pressure increase following vacuum inert is now considered to be the expected pressure response for a dump performed with the current OI-23 dump procedure. All MPS hardware performed as expected and commanding during the dump and vacuum inert was as designed. The post-dump hydrogen residual was less than the OI-22 average; however, it was greater than the expected residual for OI-23. As a result, the 5-minute bakeout period between dump termination and vacuum inert initiation was not long enough to vaporize the hydrogen residual in the manifold. This resulted in a post vacuum inert residual estimated at just less than 1 lbm which caused the subsequent manifold pressure rise to 17 psia. The pressure decay seen following the LH2 manifold pressure rise was greater than expected. The decay may be the result of leakage past seals which were exposed to cryogenic fluid. Postflight manifold decay tests could not repeat the leakage of the magnitude seen on orbit. CORRECTIVE_ACTION: The OI-23 MPS dump procedure will be modified with the following major changes. The LH2 I/B F&D valve will be open throughout the dump, the LH2 RTLS repressurization system will not be used during nominal mission dumps to preclude operating the isolation and relief valves outside of their certification (no helium pressurization), the bakeout period prior to the vacuum inert will be extended to 15 minutes, and the manual switch throw to inert the high point bleed system will be reinstated. These modifications are targeted for implementation on STS-67. Note that STS-68 (OV-105) will fly with OI-22 software and therefore, the manual MPS dump will be used. RATIONALE FOR FLIGHT: The MPS LH2 manifold pressure response seen during STS- 65 is now considered to be the expected response with the current OI-23 MPS dump procedure. The dump was adequate and it does not reperesent a safety-of- flight issue. STS-68 will fly OI-22 and use the manual MPS dump procedures. The OI-23 dump procedure will be modified prior to STS-67 to reduce the post vacuum inert residual and alleviate the hardware concern associated with introducing helium through the RTLS repressurization system. Until then, the RTLS repressurization system hardware will be certified for one flight with the current OI-23 dump procedure and a procedure is already in place for the crew to perform a second vacuum inert, if required.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	MET:	Problem	FIAR	IFA STS-65-V-09	MPS
None	GMT:		SPR None	UA	Manager:
			IPR 73V-0015	PR	
					Engineer:

Title: High MPS Helium Usage During Entry (ORB)

Summary: INVESTIGATION/DISCUSSION: During STS-65, main propulsion system (MPS) helium consumption during the 650-second entry-blowdown purge was 59.37 lbm, which exceeded the Operations and Maintenance Requirements and Specifications Document (OMRSD) File IX Volume II requirement DV41BAO.150 specification of 55.7 +/- 1.1 lbm. The blowdown purge is initiated during entry at a ground relative velocity of 5300 ft/sec and lasts until just after landing. During this time period, the aft compartment, the orbital manuevering system (OMS) pods, and the LH2 umbilical cavity area are purged with helium and the LH2 and LO2 manifolds are pressurized. The manifold pressurization continues after the purge is terminated.

Analysis completed within days of landing indicated that the entry helium consumption could be explained as normal and that no out-of-specification leakage within the MPS helium system should be expected. Postflight testing confirmed that a hardware anomaly was not the cause of the additional helium consumption. STS-65 was the first flight of the operational increment (OI)-23 software and therefore, the first use of the MPS helium system entry configuration designed for OI-23. On all flights since STS-26, only the Space Shuttle main engine (SSME) 1, 2, and 3 helium supply A-leg isolation valves have been opened during entry. In this configuration, helium for the blowdown purge and manifold repressurization is provided only through the SSME 2 helium supply A- leg regulator (through the SSME 2 crossover valve). In OI-23, the SSME 1, 2 and 3 helium supply A- and B-leg isolation valves, as well as the pneumatic system isolation valves, are opened for entry. This configuration allows three regulators (the SSME 2A and 2B and the pneumatic system regulators) to supply helium for the blowdown purge and manifold repressurization. The blowdown supply pressure can be monitored using the pneumatic accumulator pressure (V41P1650A). As a result, the helium pressure being provided for the blowdown remained approximately 100-psi higher than the average single- regulator pressure and therefore, a greater helium mass flow was delivered. Analysis indicates that approximately 3 to 4 lbm more helium consumption should be expected with OI-23. Adding 4 lbm to the nominal OV-102 flow of 55.7 lbm results in a consumption very close to the 59.37 lbm seen on STS-65. As a result of the findings from this mission, File IX requirement DV41BAO.150 will be modified to specify the expected helium consumption for each vehicle with the OI-23 entry configuration including the 3-sigma values that are calculated with all of the available data (since STS-26). CAUSE(s)/PROBABLE Cause(s): The cause of the greater-than-expected helium usage during entry on STS-65 was the configuration of the MPS helium system during entry. STS-65 was the first flight of OI-23 software which has an MPS helium system configuration that is different from that of past flights. In OI-23, three regulators are on line to provide helium flow for the entry blowdown and manifold repressurization as opposed to only one regulator being used with OI-22. As a result of this additional supply, the pressure provided for the blowdown was approximately 100 psi greater than the average for previous flights, and the resultant helium consumption increase was calculated at approximately 4 lbm. The increase accounts for the additional consumption seen on this mission. CORRECTIVE_ACTION: The OMRSD File IX Volume II requirement, DV41BAO.150, will be revised for each vehicle to specify the expected helium consumption with the MPS helium system entry configuration using OI-23 software. There were no MPS hardware anomalies and therefore, no hardware corrective action is required. RATIONALE FOR FLIGHT: The Orbiter MPS helium consumption during entry on STS- 65 was not anomalous and has no effect on subsequent missions. Higher MPS helium consumption will be expected during entry on future flights with the OI- 23 software. STS-68 (OV-105) will fly with OI-22 software and therefore the helium consumption value currently specified in requirement DV41BAO.150 for OV- 105 will be used to evaluate the system performance of that vehicle during entry.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-65-V-10	Atmospheric Rev
EECOM-06	**GMT:**		**SPR** 65RF08	**UA**	**Manager:**
			IPR 73V-0007	**PR**	
					Engineer:

Title: Left Flight Deck Smoke Detector Transients (ORB)

Summary: INVESTIGATION/DISCUSSION: The smoke detection system showed no indications of smoke generation during the flight. However, the left flight deck smoke detector (s/n 012) concentration indication dropped off-scale low for two seconds. Fourteen seconds later; the smoke detector concentration had a negative spike for a period of 5 seconds. The smoke detector concentration was normal for the remainder of the flight. Also the remaining smoke detectors showed no indications of smoke throughout the mission.

Approximately 18 hours after landing, a master alarm was received from the left flight-deck smoke detector with no concentration change observed in the data. Several days later during powered operation, a second master alarm occurred and again with no concentration change observed. No troubleshooting was performed on the vehicle. The smoke detector was removed from the vehicle and sent to NSLD for troubleshooting. The NSLD troubleshooting will try to reproduce the observed signatures and verify a failure of the smoke dectector. A sub-CAR has been issued for NSLD to perform the testing. The cause of the failure signature is unknown. CAUSE(s)/PROBABLE Cause(s): The cause of the failure signature for the smoke detector is unknown. The smoke detector failure signature is not similar to any past smoke detector problems. The failure analysis that will be performed at NSLD will be documented in CAR 65RF08-010. CORRECTIVE_ACTION: The smoke detector was removed and replaced with s/n 040. The replacement smoke detector passed the self tests. The removed smoke detector was sent to NSLD for testing, and the failure analysis will be documented in the CAR 65RF08-010. RATIONALE FOR FLIGHT: If the left flight-deck smoke detector fails completely, two redundant smoke sensors are available one in the right flight deck and one in the cabin fan package. The ground and crew can review the smoke concentration data to determine if the alarm is real.